Monterey Phoenix Project

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8 FEBRUARY 2022

Outline

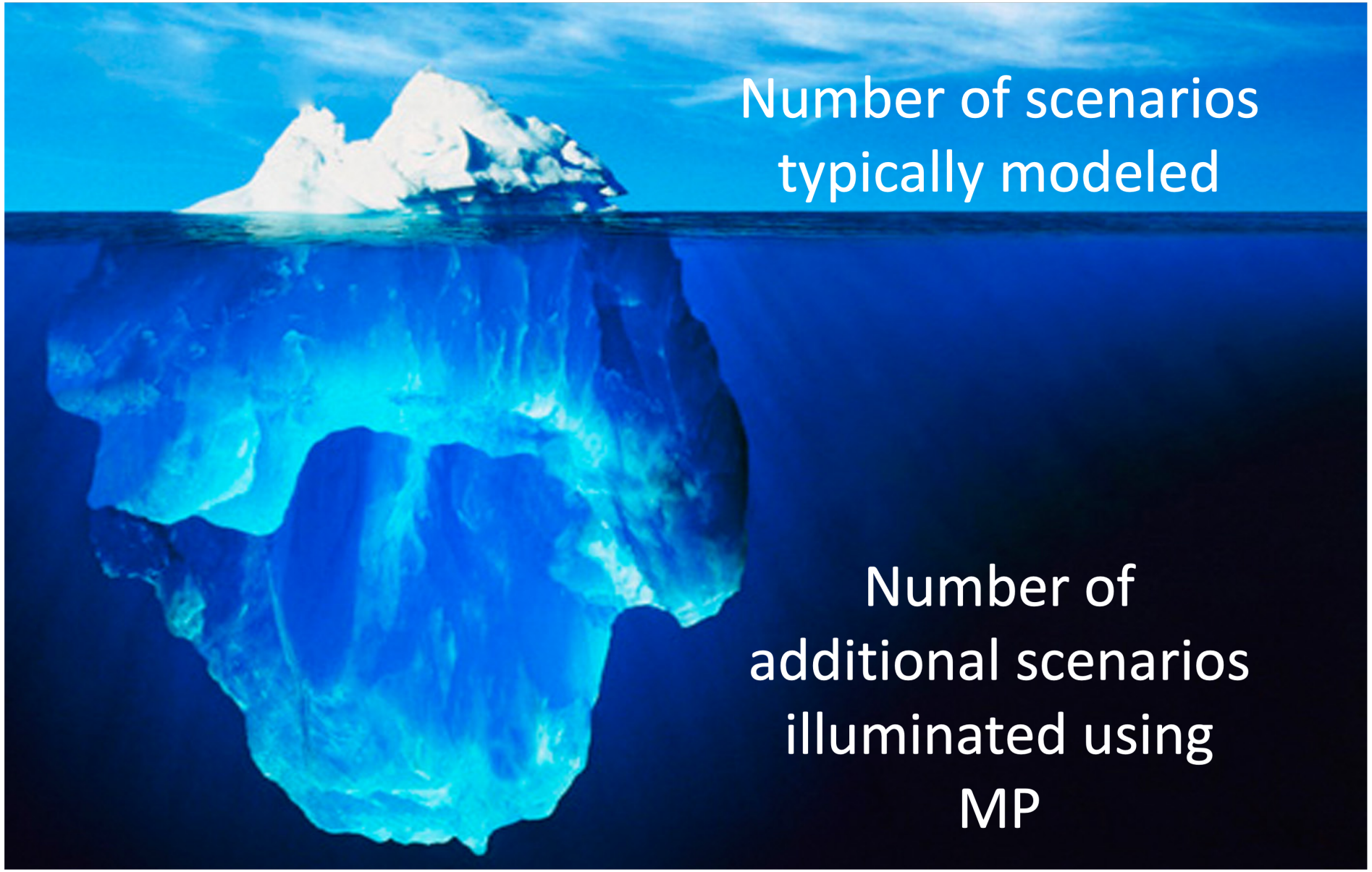
- Monterey Phoenix Overview
- Student Research Applications
- Tool Updates
- New NPS Course: SE3650 Modeling & Analysis of Emergent System Behaviors
- SysML v2 Involvement
- Engagement Opportunities

What is Monterey Phoenix?

- **Monterey Phoenix (MP)** is an NPS-developed approach and language for modeling more mission, system, and process behavior variants quickly and with less human error.
- MP brings **behaviors previously not contemplated** to its user's attention to before they are experienced in the actual mission, system or process.
- MP helps find and communicate **assumptions** you didn't realize were being made and **requirements** you didn't know were being overlooked, until realizing them in MP-generated examples.

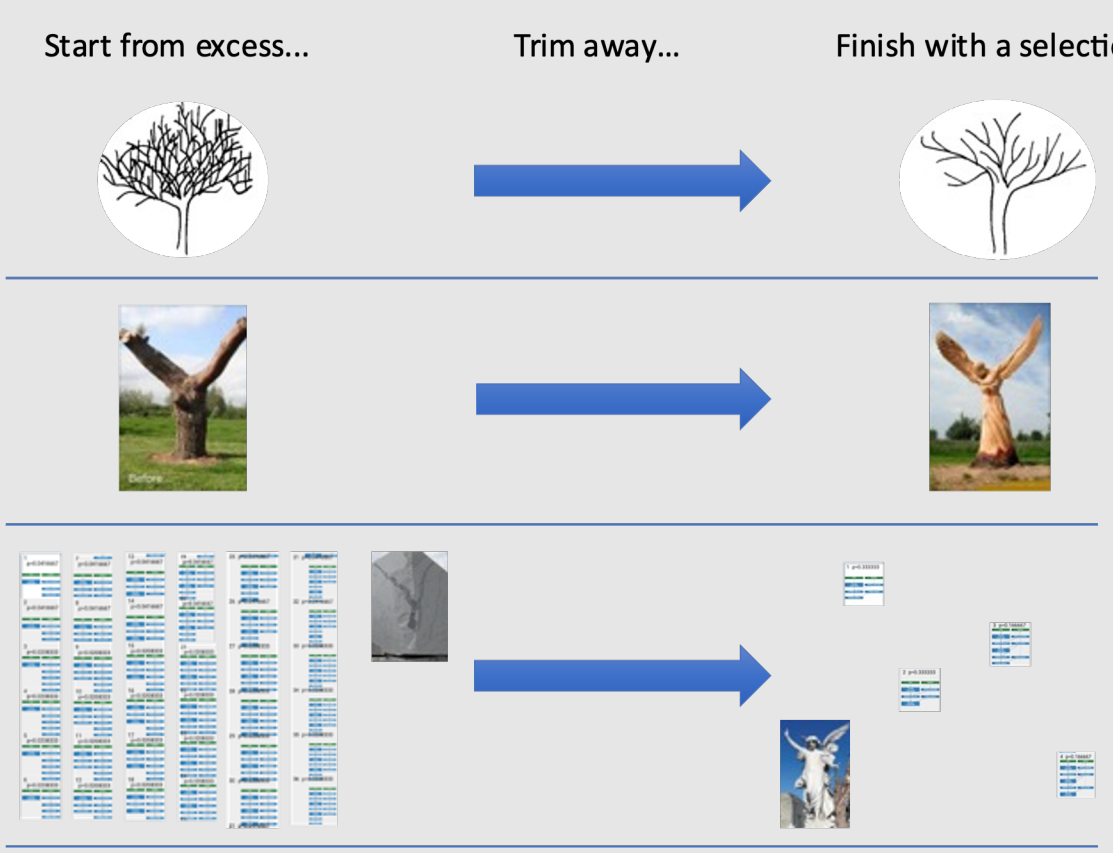
MP exposes " human blind spots so decision makers can be confident they are considering all possible risks, not just those humans were able—or willing—to identify."
– Margaret Palmieri, SES and NPS Alumnus

Auguston, M. Software Architecture Built from Behavior Models. ACM SIGSOFT Softw. Eng. Notes 2009, 34, 1–15.


Number of scenarios typically modeled
Number of additional scenarios illuminated using MP

How It Works

High Level



Technical

- Event traces emerge as a result of a derivation process guided by grammar rules and composition operations
- Trace derivation is performed top-down and left to right following the event grammar rules
- Composition operations add new relations to the trace under derivation or filter out some trace segments from the result

"The way in which one can divide up the original problem depends directly on the ways in which one can glue solutions together." – John Hughes, 1989

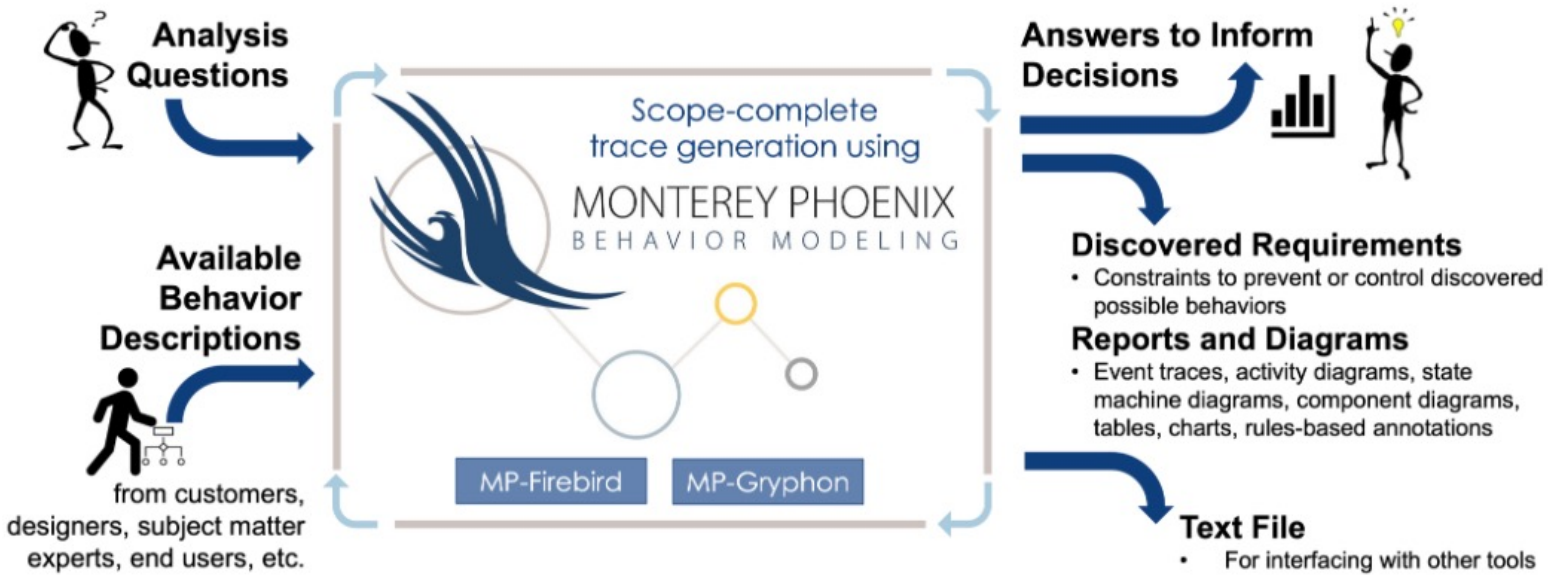
Auguston, Mikhail. "System and Software Architecture and Workflow Modeling Language Manual(Version 4)." 2020. Available online: https://wiki.nps.edu/display/MP/Documentation (accessed on 21 Jan 2022)

We use MP *models* to **ASK** and **ANSWER** *questions* *about*

delivered with *scope-complete* assurance.

Example Uses:

Application Domains
Lifecycle Phases
Emergent Behavior Analysis
Schedule Analysis
Risk Analysis
Probability Analysis
Resource Analysis
Cost Analysis



Personal Protective Equipment (PPE) Supply Chain Analysis

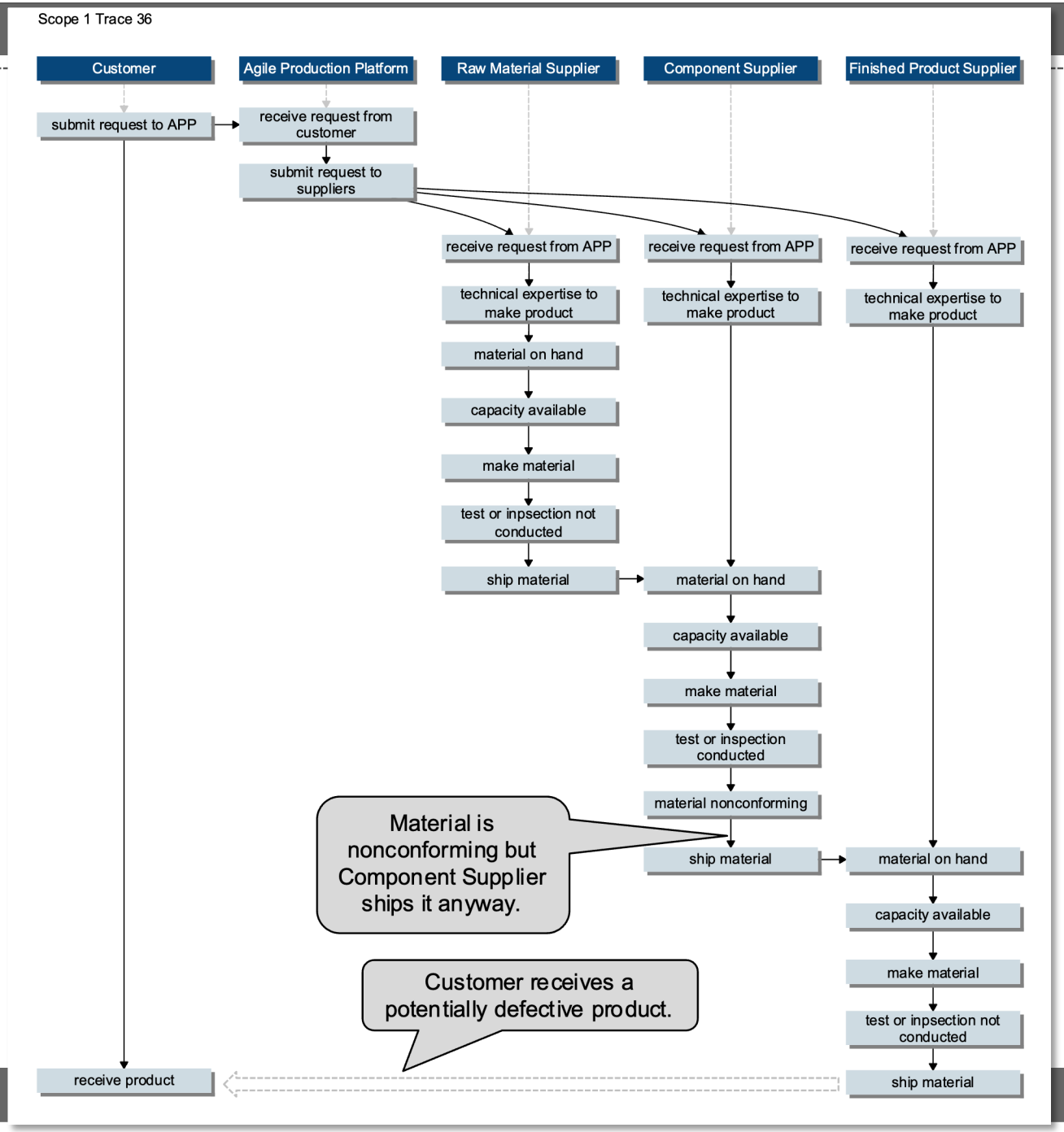
Joshua P. Beaver

- System of focus was the Agile Production Platform (APP), a marketplace that aspires to aggregate PPE systems and materials to solve COVID-19 supply issues
- Used MP to find desired and undesired scenarios of PPE supply chains within the APP
- Example of undesired but expected behavior
  - A disconnect between the customer, the APP, and the delivery service results in a shipment not arriving as expected.
- Examples of undesired and unexpected behaviors
  - A counterfeit part makes its way into the APP supply chain
  - Nonconforming material makes its way to the customer through miscommunication or lack of inspection
- Resulted in recommendations to minimize the probability of occurrence in the actual system once it is deployed
  - The APP should require suppliers to follow international standards ISO 16678 and ISO 9001 (for counterfeit avoidance and quality management, respectively),
  - The APP should implement rating systems to verify that the products received perform as expected and to measure on time delivery and quality.

Beaver, Joshua. "Analyzing Emergent Behavior of Supply Chains for Personal Protective Equipment in Response to COVID-19." Master's Thesis, Naval Postgraduate School, September 2021.

Personal Protective Equipment (PPE) Supply Chain Analysis

Joshua P. Beaver



Beaver, Joshua. "Agile_Production_Platform_Supply_Chain_Interaction.mp." Available online: https://firebird.nps.edu, Import menu, Application_examples folder. September, 2020.

Supply Chain Cyber Attack Risk Analysis

Margaret Palmieri

- The ransomware attack against the Colonial Pipeline in May 2021 highlighted the vulnerability of American infrastructure, specifically the fuel supply chain, to cyber-attack
- Used MP to help decision makers assess, visualize, and prioritize cyber threats to a supply chain
- Applied methodology published by Navy Lieutenant Commander Richard Moebius:
  - create a behavior model of the intended operation
  - add negative alternatives to the operation
  - add risk attributes (e.g., impact and likelihood)
  - calculate or assign impact to negative outcomes
  - calculate or assign likelihood to negative outcomes
  - use impact and likelihood to calculate risk
  - output desired format of risk for decision makers
- Extended methodology with global reporting of risk across all event traces

Palmieri, Margaret. "Assessing and Visualizing Risk in Monterey Phoenix through a Supply Chain Cyber-Attack Use Case." Master's Thesis, Naval Postgraduate School, September 2021.

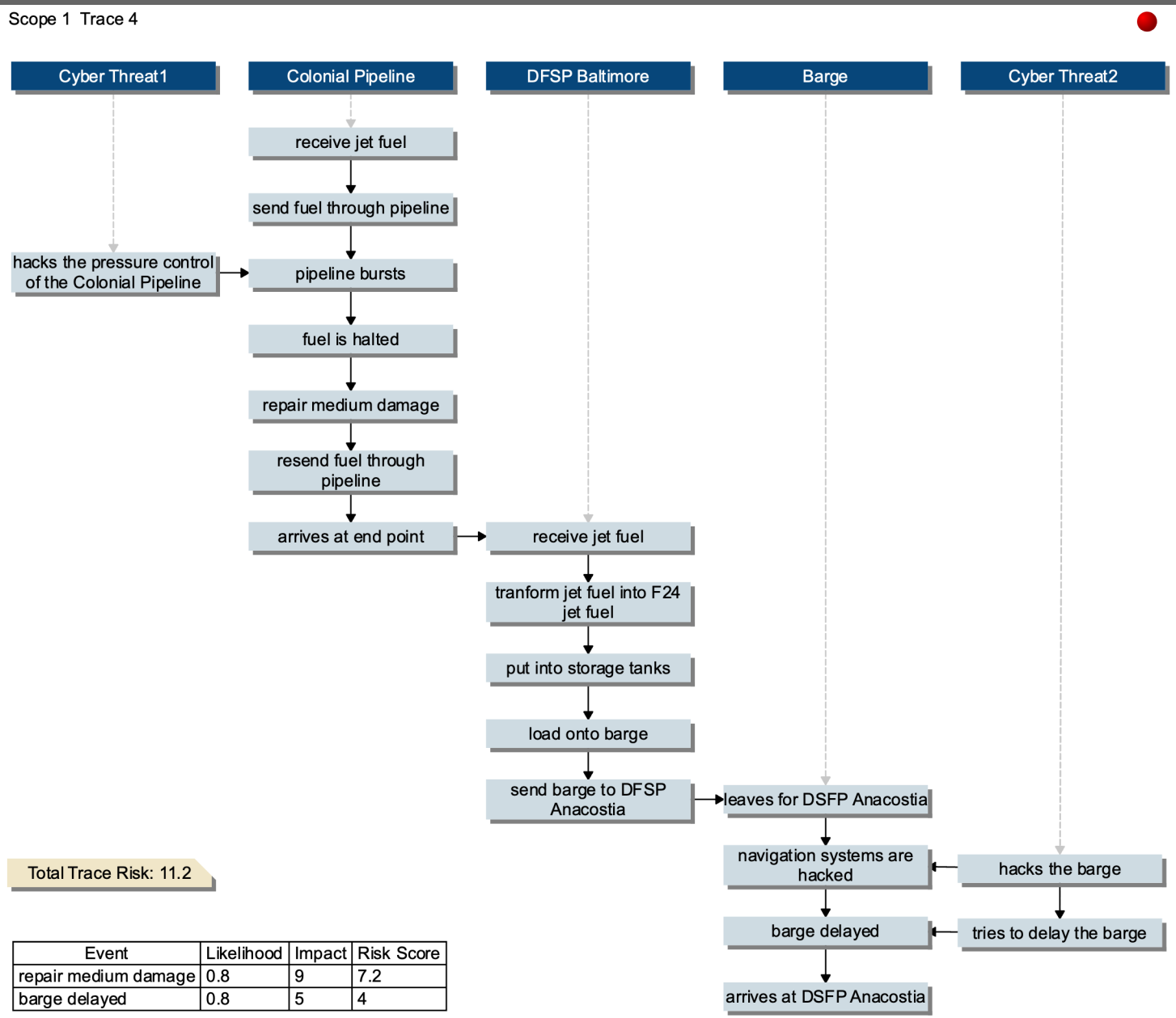
Supply Chain Cyber Attack Risk Analysis

Margaret Palmieri

Global view

Risk Report for Scope 1

Total risk over 12 traces (sum of trace risk scores): 76
Highest Risk: 11.2 (trace 4)
Average Risk: 6.33333
Sort by Marked to view traces with above average risk >=9.



Event	Likelihood	Impact	Risk Score
repair medium damage	0.8	9	7.2
barge delayed	0.8	5	4

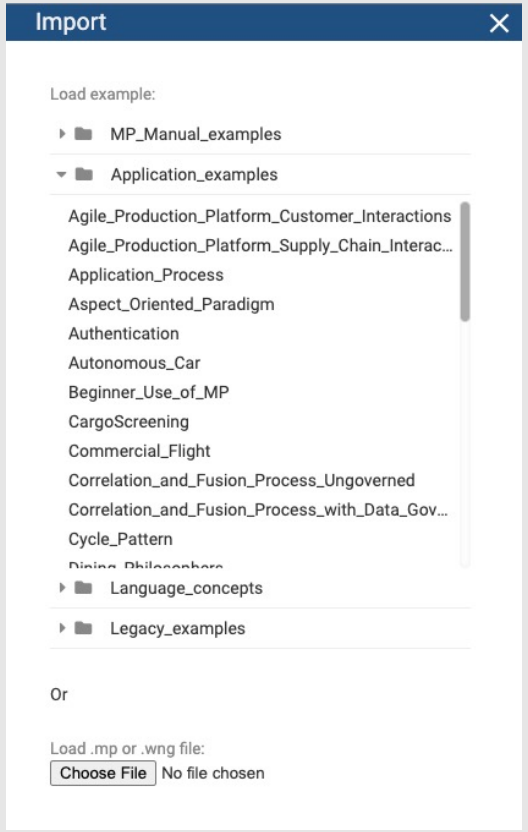
Palmieri, Margaret. "Assessing and Visualizing Risk in Monterey Phoenix through a Supply Chain Cyber-Attack Use Case." Master's Thesis, Naval Postgraduate School, September 2021.

Tool Updates

MP-Firebird

https://firebird.nps.edu **web application, all OS**

- dark mode
- grayscale color scheme
- find and replace
- word wrap
- split screen
- browser cache clearing
- refreshed and expanded set of example models with cross references to the MP manual and student research
- Guest accounts for government sponsors with model storage, auto-save, and sharing & collaboration features



MP-Gryphon

https://nps.edu/mp/gryphon **open-source download, Linux**

- improved menu organization
- improved activity diagram rendering
- improved table alignment
- model directory search
- dark mode
- find and replace
- word wrap
- split screen
- refreshed and expanded set of example models with cross references to the MP manual and student research

New NPS Course

SE3650: Modeling & Analysis of Emergent System Behaviors

- Module 1: Emergence in Systems
- Module 2: Introduction to Behavior Models and Monterey Phoenix
- Module 3: The Small Scope Hypothesis
- Module 4: Detection, Prediction and Classification of Emergent Behaviors
- Module 5: Midpoint Progress Check
- Module 6: Control of Emergent Behaviors
- Module 7: Probabilities
- Module 8: Real Time, Resource, and Risk Analyses
- Module 9: Preparation of Final Presentations
- Module 10: Final Presentations to Leadership

Link to Catalog Description

- "We gained a lot of hands on experience with a tool that provokes thought and innovation. I feel like this is something I can use in my career for whenever I need some new perspective."
- "A strength of the course outcomes for me was learning new, practical points of view on my existing work and providing a new tool for communicating these points of view. I also appreciated the course module mini lectures and exercises."
- "The Web UI made the barrier to entry very low and makes MP approachable, even though I enjoyed the extra performance of Gryphon."
- "The modules and hand outs were great reference materials for trying to understand the material. The online coach help was also needed and good to have."
- "I liked the pacing of the course. It flowed well between learning how to set up basic models, and then transitioning into adding actual analytical data to them by the end of the class."

SysML v2 Submission Team Participation

- Onboarding with SST on 21 February
- Starting participation in the Execution Working Group
  - Work on SysML behavior model execution semantics
  - Crosswalk MP and SysML behavior specification semantics and align where practical
  - Objectives are to
    - Integrate MP concepts and modeling lessons learned into SysML v2
    - Facilitate smooth conversion between SysML and MP behavior models

Take Aways

- MP can help you find and communicate:
  - what could go wrong that may not have otherwise occurred to you – or anyone – until it's too late.
  - possible inefficiencies due to previously unconsidered exception cases.
  - examples of scenarios that could cause serious failures or waste, for early correction.
  - risks to cost, schedule, technical performance, safety and security.
  - assumptions you didn't realize were being made and requirements you didn't know were being overlooked, until realizing them in MP-generated examples.

Engagement Opportunities

Sign Up for the MP Newsletter

https://forms.office.com/r/GW313XiMRV

Questions?

Monterey Phoenix and Related Work:
https://nps.edu/mp
https://firebird.nps.edu
https://nps.edu/mp/gryphon
https://nps.edu/mp/models

MONTEREY PHOENIX
BEHAVIOR MODELING

MilSuite Website (CAC):
https://www.milsuite.mil/wiki/Monterey_Phoenix

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